## THE ART OF ETCHING.

EXPLAINED AND ILLUSTRATED; WITH REMARKS ON THE ALLIED PROCESSES OF DRYPOINT, MEZZOTINT, AND AQUATINT.

BY H. R. ROBERTSON.

PERHAPS it may be as well to begin by saying that by etching we do not mean pen and ink drawing on paper. The art of etching is, however, a simple means by which such persons as are skilled in pen and ink drawing may reproduce their designs in large numbers with greater delicacy and an added depth of effect.

Etching is a substitute for engraving on metal, in which the strokes, instead of being cut with a tool are corroded by an acid, by which means the effect of engraving is produced with great expedition. The plate is covered with a thin coat of wax, or other substance upon which the acid employed has no power; the lines are drawn with a needle so as to cut through the wax; the plate is then immersed in the acid till it has corroded the metal to a sufficient depth wherever the lines have been drawn. A print from the plate is produced by filling the lines with ink, and, after having laid damp paper upon the surface, subjecting it to such pressure as forces the paper into the lines. By this means the ink is transferred to the paper, and the result is an impression or proof. It will be thus seen that the process is the reverse of that of woodcut or type printing. In a woodcut the untouched surface only prints, the engraved parts producing white; in a copper plate the surface, being wiped clean, produces white, and the engraved lines yield the print.

Comparison of a section of the etched line with the engraved line on copper shows us a furrow somewhat resembling the shape of the letter U in the former case, and of the letter V in the latter. There is, consequently, a greater quantity of ink held in the etched line, with a corresponding gain of richness of effect in the line when printed.

The natural capabilities of the art of etching are very great, and there seems to me no reason for restricting its range, as some writers have been inclined to do, to such subjects only as can be rapidly and decisively sketched. The fact that it is peculiarly suited for the free expression of artistic thought does not prevent the fact being equally true that it is perfectly adapted to such elaborate work as can only be done slowly. Undeniable successes have been produced in both ways, and that is surely a narrow view of the art which declines to recognize both as true etching. The present stimulus to the art of etching has come to us from France, where painter-etchers have, for the most part, adopted a rapid and sketchy manner, and we may be grateful to our neighbors for the revival of a better style of work than was being generally shown by our own countrymen, without adopting any such limitations as are found in the practice of a particular school.

### MATERIALS AND TOOLS.

It is absolutely necessary to be provided with the following articles: Copper plates, a ball of etching ground, a dabber, etching needles of different sizes, a drypoint, some nitrous or other acid, porcelain baths, a bottle of stopping-out varnish, an oil rubber, a scraper, a burnisher, a blind or shade, a bridge or rest.

Besides the above, which are specially etching requisites, the beginner must be furnished with several bottles with glass stoppers, a large bottle of spirits of turpentine or benzine, some wax tapers, a vise with wooden handle, some soft white blotting paper, tracing paper, whiting, washleather, some thick sticks of charcoal, crocus powder, an oilstone, water color brushes of different sizes in quill, the finest emery paper, a supply of old rag.

With the above-named tools and materials the student may commence etching, but should he make up his mind to follow the art seriously, he will find it desirable to supply himself with a bottle of (so-called) liquid etching ground, a roller for laying the (so-called) etching ground, some gravers or burins, tracing gelatine, transparent etching ground in a ball.

Methylated chloroform and ether for making solutions of etching ground—the liquid etching ground properly so-called.

A steel anvil, hammer, and callipers.

*The Plate.*—The plate should be of copper, even in thickness, perfectly smooth and sound, neither porous nor very hard. It can be tested by dropping some diluted acid on the surface, and, after washing it off, seeing whether the roughening produced is uniform. Another test is to engrave upon it with the burin, when a judgment can be formed by the resistance the metal offers. But both tests are only available by those who have had considerable experience. Fortunately, we are so well supplied with excellent plates by the first London houses, that the beginner may take for granted that his plate is all right. The only thing I would warn him to bear in mind is, that some plates are decidedly softer than others, so that any notes made of the depth of line produced by a certain length of exposure to acid of a given strength cannot be implicitly relied upon for future guidance. The price of the smaller plates is calculated by the area—usually three farthings the square inch; the larger plates are sold by the weight, and cost about 3s. 6d. per pound. It is advisable when ordering a plate to have it beveled at the edges, as when not beveled it is apt to cut the paper, on its being passed through the rollers of the printing press. Plates that have been etched unsuccessfully can be used again by having the surface replaned by the maker; in the case of large plates the cost of this averages about half their original price. No price is quoted for this work, as the expense depends upon the depth to which the lines may happen to be bitten, and upon such uncertain conditions, as the workman finding faulty places in the plate which must be planed till removed. In the case of plates under the size of ten inches by eight, it is not worth while having them replaned, as the cost of doing it sometimes exceeds the price of new copper.

Zinc plates are much cheaper than copper, but, owing to the more porous nature of the metal, the lines produced are coarser and not so clean; it is well adapted to the expression of all objects which are commonly described as picturesque, such as ancient buildings, cottages, rocks and uneven ground.

Steel is not to be recommended for etching, as it is so very liable to rust, and any advantage over copper which it formerly possessed is now neutralized by the device of coating the copper with an electro deposit of iron. This process, known as steel facing, will be alluded to later on.

*The Etching Ground.*—Etching ground may be bought ready prepared; it is commonly sold in balls about the size of a walnut, at the price of a shilling each. Before using, it should be tied up in a piece of fine silk.

A great many ingredients have been used for making the ground by different artists. The following is a good simple recipe: Asphaltum, 3 parts; burgundy pitch, 2 parts; white wax, 1½ parts.

A pot of glazed earthenware is to be used over a slow fire. The asphaltum must be powdered and melted first, and the other ingredients, being added as soon as it is in a state of fusion, are thoroughly mixed with it by being stirred with a glass rod; the whole is then poured into warm water, and kneaded into balls. Care must be taken to prevent its burning while on the fire by using a low degree of heat. In winter rather more wax should be used, so as to make the ground somewhat softer.

To prepare the liquid ground recommended by Hamerton, the ordinary ball of etching ground is broken into small pieces and put into a pint bottle of ether. The bottle must be well shaken three or four times a day during three days, and then allowed to remain for three weeks. The solution will now have divided itself into two distinct parts, a thin transparent part above, dark in color, and a muddy part below. The thin portion is to be poured off into another bottle, carefully leaving the muddy deposit behind. It should be again allowed to stand for three weeks and again decanted. The result is a solution fluid as water and entirely free from impurities. A somewhat similar solution is made by breaking up the ordinary etching ground in chloroform. In order to purify this preparation it is necessary to strain it several times through the finest muslin.

Transparent etching ground consists of white wax, 5 parts; gum mastic, 3 parts.

*The Dabber.*—A dabber may be made in the following manner: Cut a circular piece of stout cardboard two or three inches in diameter; on this lay a bunch of clean horsehair, and over this again some cotton wool. Cover the whole with a piece of clean silk, draw it tightly over the cardboard and tie with a string, cutting off what is superfluous but leaving enough to hold it by. Sometimes fine kid is used instead of silk.

*The Etching Needle and Drypoint.*—Etching needles are generally made of pieces of steel wire, about two inches in length, inserted into cylindrical handles of hard wood about five inches long and a third of an inch in diameter. They are made of different degress of fineness, and the beginner should have at least two or three of them. For very fine work common sewing needles of the stoutest sort do perfectly, and handles are sold in which they may be used. These handles are of wood, split so as to receive the needle, which is kept firm by a moveable brass ring round the wood. The common mathematical pen does for a holder, a little sealing wax being employed to secure the needle after the screw has been tightened as much as possible.

To sharpen an etching needle pass it backwards and forwards in a small groove made near one end of your oilstone, holding it down flat and turning it continually. When it has attained a high degree of sharpness, describe a large circle with it on a piece of cardboard, and still holding it tightly between your fingers go on describing circles of a continually decreasing size. The nearer you approach to the center the more vertical must be the position of the needle. The fineness or coarseness of the point is regulated by keeping the needle away from, or bringing it nearer to the center of the circle.

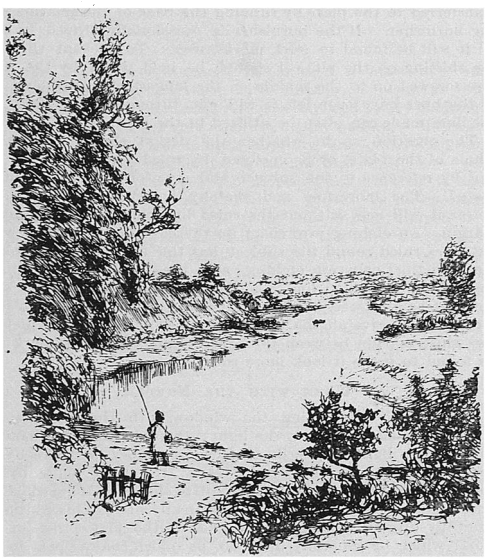
The very best etching needle possible is one the point of which is made of a diamond. This is a costly tool, and one

which the beginner can certainly dispense with. The price is a guinea for one of these needles. The great advantage of the diamond point is that it always remains the same, never requiring to be sharpened, and not scratching the copper more on one side of the point than the other, as often happens when the ordinary needle has not been properly ground. A diamond has the further advantage, that the etching ground never adheres to it, as it sometimes does to steel. When used with a little pressure the diamond readily cuts into the copper, so that this tool also serves as a drypoint.

The ordinary drypoint is a tool made entirely of steel, pointed at each end, and is used for cutting lines into the copper without having recourse to the acid. The drypoint must be ground with flat faces rather than round, so as to have a cutting edge.

*The Acid.*—Individual etchers differ much as to the acid they prefer to use. That most commonly employed for etching on copper is nitric acid of the specific gravity of 1·420. To make the bath an equal quantity of water is added.

Nitrous acid is very similar to nitric, but is, on the whole, preferable, being more regular in its action. The fumes from this acid are, however, more disagreeable, and care must be taken to inhale them as little as possible. Nitrous acid of the specific gravity of 1·360 is generally used. Nitrous acid is one tenth less powerful than nitric, so that to make a bath of nitrous acid equal in strength to the nitric bath mentioned, we must take ten parts of acid to nine parts of water.



Fielding mentions as the proportions to be used for the bath one part of nitrous acid to five parts of water, with the addition of sal ammoniac in the proportion of the size of a hazel nut to one pint of the mixture.

For etching on steel or zinc one part of acid to seven or eight of water is sufficient, and even with this weak mordant the biting is very rapid.

The mixture of water with these acids produces heat, which must be allowed to subside before the mordant is poured on the plate. Should the clothes be splashed at any time by the acid the spots should be instantly washed with spirits of hartshorn, which neutralizes the acid. As black cloth turns scarlet where it is spotted by the acid, it is as well for the etcher to provide himself with an apron of some such material as American cloth.

Mr. Haden's bath is composed of two parts of chlorate of potash, ten of hydrochloric acid, eighty-eight of water. The water is to be warmed and the chlorate of potash perfectly dissolved in it first; then the acid is to be added.

*Porcelain Baths.*—Glass, india-rubber, or vulcanite are employed as well as porcelain for making these trays, which are to be bought, of various sizes, at the shops for photographic materials. A shallow tray of wood is sometimes used, which must be painted thoroughly several times inside and out with Brunswick black, in order to resist the acid. A lip or spout should be fashioned at one corner of the bath for pouring off the acid after use. The superiority of the porcelain bath consists in its being able to stand the heat of the iron plate with gas jets under it, which is used in the case of the etcher wishing to work with his mordant at a uniform temperature.

The old method, now almost entirely superseded, consists in bordering the plate with wax, which is softened in warm water and fastened vertically round the edges of the plate, so that it forms the sides of a tray, the bottom of which is the copper-plate to be etched. To prevent leakage, heat a key and pass it along the wax so as to melt it where it adheres to the plate; on the wax re-hardening, its solidity should be tested with water before risking the acid on the plate. This process of bordering with wax is troublesome, but may be used when the size of the plate happens to exceed that of any tray which the etcher possesses.

*The Oil-Rubber.*—The oil-rubber should be made of woolen cloth rolled up as tight as possible, and tied round with string; one, six or seven inches long, and two inches or two inches and a half in diameter, is as large as is ever wanted. Where a small one is required, a piece of cloth laid over your forefinger may be advantageously used, or a piece of very soft cork will do. The oil-rubber is used with oil alone or with oil and crocus powder.

*Stopping-Out Varnish.*—This may be bought ready prepared, or the etcher may make a varnish which will answer the purpose by following this simple recipe. Break small bits of resin into a phial, pour in spirits of turpentine to about twice the hight of the resin. Heat in a sauce-pan of water; add a little lamp black.

Brunswick black is commonly used as a stopping-out varnish, but does not always dry so readily as might be wished.

*The Scraper.*—The scraper is an instrument of nice-tempered steel, having three-sides, each of which is slightly fluted. It is used to remove the burr occasioned by the drypoint, and to efface faulty passages. The oilstone to sharpen it on should be a piece of the best Turkey hone used with olive oil. A stone rather too hard for the razor is excellent for this tool, which must be held flat on the stone while being sharpened. To test its sharpness pass the edges over your finger-nail, and if any tooth or bluntness is discoverable the grinding must be continued, or the scraper will scratch the plate.

*The Burnisher.*—The burnisher is made of polished steel; it is used to take out slight scratches on the plate, and to lessen the force of lines that are too deeply bitten. This tool requires to be taken great care of, as it rusts very easily and is only of use when in a condition of brilliant polish. This polish is preserved by rubbing it along a groove in a piece of soft deal, made just wide enough to hold it. If it should at any time lose its polish, some emery powder must be used in the groove, and the final lustre obtained with Tripoli powder and olive oil.

*The Blind or Shade.*—The blind or shade, is made of tissue paper stretched upon a frame, and placed between your work and the light, to enable you to see better the lines on the surface of the bright copper. A very convenient one is made in the following mann r: Take a heavy piece of wood about three inches broad, one inch thick, and considerably longer than your plate; then take a piece of stiff wire and place the ends of it in each end of the wood so as to form an arch, over which stretch tissue paper; the wire may be bent to any shape that is required. No frame-work is better for one of these translucent shades than a common wedged frame made for straining canvas for oil painting; as these stretchers can be bought of all sizes and varying proportions, one can be selected which is suited to the work in hand.

*The Bridge or Rest.*—This is a thin board planed smooth, with the edges sloped off, and of a length and breadth proportioned to the size of the plate you are working upon. At each end is fastened a piece of wood, sufficiently high to raise it above the plate, the object being to prevent the damage which might be done to the ground by resting the hand upon the plate. I have, however, found the chloroform ground so firm that the bridge could be dispensed with, and one could work safely with only some sheets of soft blotting paper between the hand and the plate. Of course care must be taken to keep the blotting paper steady, and not to allow it to shift about under the hand.

*Charcoal.*—The charcoal used to reduce the surface of the copper in over-bitten parts is made of willow or some other soft wood. It is to be had for the purpose in sticks of an inch or inch and a half in thickness. Different pieces will be found to vary in quality, the heaviest being the hardest and having the coarsest tooth. It is cut transversely and used flat on the plate, either with oil or water. The outer surface of these thick sticks of charcoal is always very hard and must be scraped off near the end which is being used, or it will scratch the copper.

*The Gravers or Burins.*—These tools should be of different forms from the extreme lozenge to the square; the lozenge being for fine, and the square for broad lines. To sharpen the graver, lay one of the flat sides on the oilstone, keeping the right arm close to the side, and the forefinger of the left hand pressed upon that side of the graver which is uppermost; next sharpen the other side in the same way. The face or point is sharpened by holding the graver firm in your hand, with the sharp edge upwards, in such a slanting position as will bring the face flat

on the stone and rubbing it backwards and forwards. Care must be taken to do this evenly, so as not to make more than one face on the point. It is well before leaving off rubbing to hold the graver so as to slightly square the point.

*Anvil, Hammer, and Callipers.*—The anvil is made of polished steel, and is very slightly convex. When not in use it should be coated with melted wax, or painted over with linseed oil, as exposure to the air soon causes it to rust. Should this occur, it must be taken to the toolmaker to be re-polished, an operation which is troublesome and costly.

The larger end of the head of the hammer is flat and the smaller end round.

The callipers are large iron compasses, the ends of which are turned inwards, so as to exactly meet, an arrangement similar to that of an ordinary pair of tongs. Of the ends of the compasses one is kept sharp and the other purposely blunted.

### LAYING THE GROUND.

The first thing to do will be to clean the plate thoroughly. Rub it well with a soft cotton rag and benzine or spirits of turpentine; finish with whiting, which must be removed with a clean rag. Now take hold of the plate in the middle of the longest side with the hand vise, inserting several thicknesses of blotting paper, so as not to mark the plate. Hold it in your left hand over a stove or gas jet till it is heated evenly throughout, and with the other hand press on it the ball of etching ground, wrapped up in silk. As soon as the ground melts through the silk, rub it all over the surface of the plate, taking care that the plate remains just hot enough to melt the ground. If it is too hot, the ground will begin to boil and will finally burn. The bubbles caused by boiling are apt to leave airholes in the ground, through which the acid may bite little holes in the plate; burning ruins the ground altogether, so that it cracks off under the point, or flakes off when immersed in the acid. After you have distributed the ground all over the plate, you dab it with the dabber till it spreads evenly throughout. If this is properly done, the ground will be thinly and evenly spread, and of a clear golden color, showing the shine of the copper well through it. An extremely thin layer of ground is sufficient. If you have too much, you may clean the dabber repeatedly on a piece of coarse muslin. In this way the superfluous ground is easily removed.

The process we have described of laying the ground before commencing is the old one, and the one still most generally in use. The ground thus laid, however, is inferior to that produced by the solution of chloroform or ether—the liquid etching ground. This is poured on to the copper plate in the same way as photographers apply collodion to their glass negatives. The plate may be held in a vise, as in the old process, or better still, held underneath by a pneumatic holder. The liquid must be poured on the middle of the plate till it makes a pool reaching to the sides. The plate is then to be inclined, so that the solution may run first to one corner then to another, till finally all that is superfluous is poured back into the bottle.

A third way of laying the ground is with the roller (generally used for re-biting) and the thick paste commonly called liquid etching ground. Some of this paste is put out on to another plate and rendered more liquid by the addition of a few drops of oil of spike. The roller is now passed backwards and forwards over it till it is evenly charged with the ground. It is now transferred to the plate to be etched, and rolled well over in all directions. Both plates must be thoroughly heated during the process. This method answers perfectly when the plate is quite flat throughout, which in a large one is seldom the case.

It is important to select a room that is free from dust flying about when performing the above operations, particularly when employing the liquid etching ground, as specks of dust are apt to cause foul biting. If any are noticed, they should be touched with stopping-out varnish before biting in.

### SMOKING THE GROUND.

Still holding the plate with the hand vise, heat it again from beneath, and watch the surface till the ground melts sufficiently to make it shine all over. Then, without allowing it to cool, with one hand hold it up in the air inverted, and with the other hold burning wax tapers, twisted together, underneath it. The flame should just touch the plate, no more, and should be passed rapidly along its surface, never resting at one place, or else it would burn it. If this is properly done, the smoke will incorporate itself with the ground all over the plate, and the result will be an even black surface of a somewhat polished appearance. Should it be found that the plate is only partially blackened it may be heated again, and again smoked. If the ground has been allowed to cool, there will be dull places where the smoke is not incorporated with it, and if the flame has been allowed to remain on one spot, dull places will occur, showing that the ground has been burned.

### THE TRACING.

The plate being now prepared, the next step is to make a tracing of the subject, for which purpose use an H.B. pencil and ordinary tracing paper.

The common process of tracing through paper prepared with black lead or red chalk may be employed, but there are better modes of transfering the tracing to the etching ground. The first we shall speak of requires the etcher to have access to a copper-plate printing press. The tracing having been placed between sheets of damp paper for a short time, is to be laid face downwards on the plate, and passed through a printing press with the same degree of pressure used as in taking proofs; it will then be found that the design is transferred to the surface of the plate, and that the lines, by aid of the blackened ground, may be seen as distinctly as pencil marks on drawing paper. Another mode, where recourse cannot readily be had to a printing press, is by damping the tracing in the same way, laying it on the plate, putting a card at the back, and passing the burnisher rapidly and somewhat forcibly over it in every direction. In this case the tracing paper must be a little larger than the plate, and the edges of the paper brought around and pasted at the back of the plate, so as not to allow it to shift its position during the process.

Instead of tracing paper it is advisable to use tracing gelatine for figure subjects or any other work requiring great accuracy and minuteness. This material is as transparent as glass, and the design is to be scratched on it with a fine etching needle. A burr is thus raised, which may be polished off by rubbing well with a cotton handkerchief. If the scraper is used to remove the burr the utmost care will hardly prevent its scratching the gelatine, and every scratch will be transferred. Passing the fingers over the gelatine will enable the etcher to tell when the burr is thoroughly removed. Some black lead powder must now be dusted over and rubbed into the tracing, which may be transferred to the plate by rubbing the back of the gelatine with the burnisher. If the burnisher is occasionally dipped in olive oil it will be found to work more freely. To prevent the tracing shifting on the plate it should be held down by the hand vise screwed on to the middle on the longest side. Should any of the burr have been left it will cut through the ground, but the lines made can often be utilized in the etching.

The question as to whether the design should occupy the whole of the plate, or be enclosed by ruled lines, is to be settled by reference to the subject and style of execution contemplated. The more free and sketchy an etching is to be, the better it will look without the ruled line and its accompanying margin. An etching worked up to the edge of the copper without lines ruled round the subject has the advantage of looking more distinctively an etching, and the less like an ordinary engraving; the ruled line is in itself not in harmony with such etchings as are freely sketched. On the other hand, when it is attempted to give all the variety of tones of a finished picture, the white margin between the subject and the plate mark will be found to make it look more complete.

### WORK WITH THE NEEDLE.

The etcher sits facing the window with the tissue paper screen between him and the light; this obviates the dazzling effect of the light on the lines of bright copper laid bare by the needle. Owing to this brightness of the lines made by the needle on the black ground a deceptive effect is produced of the lines being closer together than they really are. This illusion is painfully dispelled when the etcher sees the first proof of his work, which he generally finds to be much more open in the lines, and therefore much less finished than he had fondly hoped.

It is necessary to have several needles of different degrees of sharpness—one for foreground work being very blunt indeed. In very large plates the point of a penknife may be used for bold touches.

A large soft brush is to be kept constantly at hand to remove from the plate the particles of etching ground detached by the needle.

A varying pressure applied to the needle in making the strokes on the copper has a very appreciable effect on the eventual result. If just sufficient force is used to bare the copper without scratching it, the acid will be slow in attacking the lines, but in places where the copper has been deeply scratched the acid will attack the lines instantly and vigorously. In this way considerable gradation is often unconsciously obtained, it being natural to draw the darkest parts with the greatest firmness. Care must be taken, however, in all cases to really touch the copper, as sometimes very delicate lines leave a thin film of ground which resists the acid in parts, producing lines some of which are broken, while others fail altogether.

The sort of line work which is to be done with the needle must bear reference to the kind of biting in that the plate is to be subjected to. A small subject is sometimes etched in such a way as to produce almost an exact reproduction of the pen and ink drawing. In this case the biting-in is of the simplest character, with little or no gradation in the depth of the lines, the darks being for the most part produced by the lines being laid closer together. I may mention Pierre Billet's plate "Washerwomen," in Hamerton's third edition of "Etching and Etchers," as apparently done in this fashion. This is a simple method and is easy for a beginner, but has to be departed from when

any attempt is made to realize what is distinctive in etching, and to produce the utmost possible effect. In fact, in its general management of the lines, the most finished technical process, that of M. Lalanne, reverses the simple method just mentioned. The darkest lines ought to be kept well apart from each other, those which are to be of medium strength ought to be nearer, and very light lines out to be quite close to each other. This principle is thus expressed by Hamerton:—The breadth of the white spaces between the lines ought to be in proportion to the depth of the biting. The chief reason for this apparently inconsistent proceeding is that the lines widen under prolonged action of the acid, and so, if laid very close, they are apt to run together and make an opaque blot. Another reason for this rule is that in skillful printing of dark shadows, some of the ink is brought out of the deep lines and made to tone the white spaces left between them. The result thus attained unites the two most desirable qualities in dark shadow, depth and transparency.

All such rules as this must, however, be applied with judgment, and never taken absolutely. For instance, we may find that in the extreme distance of a landscape, the lines can hardly be made too fine or put too close together, and yet the sky which is to be still lighter must have its fine lines left more open.

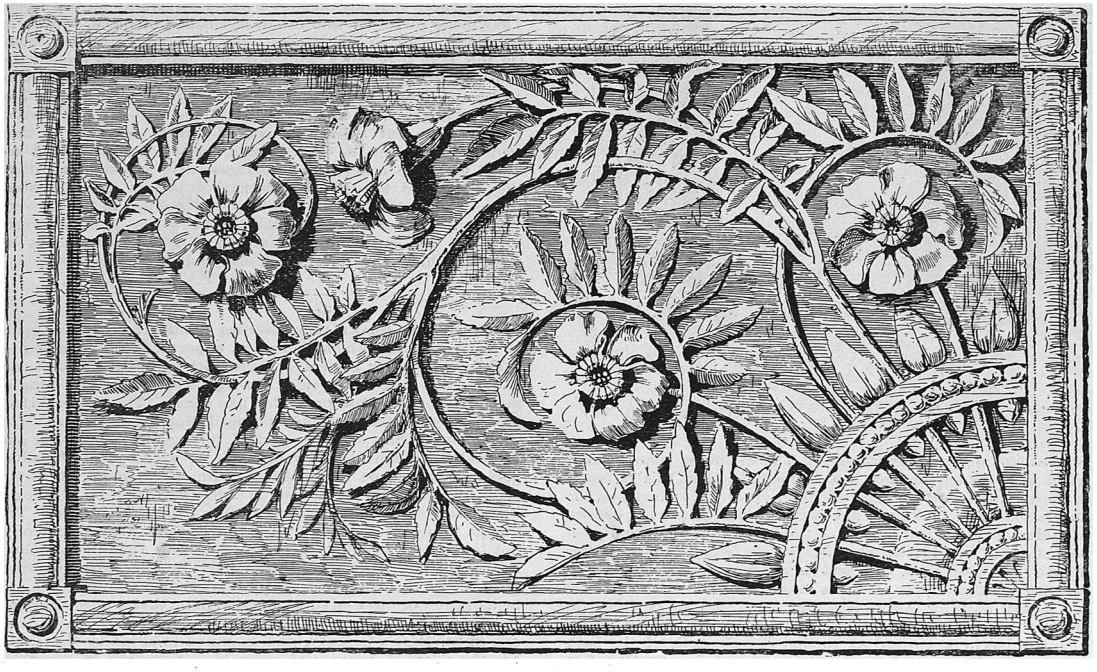
Should the etcher wish to take out the lines that he has drawn, they must be painted over with the stopping out varnish. When the varnish is dry and not yet hard, other lines can be drawn through it, but it is not so easy to work upon as the original ground. Should, therefore, any very serious alteration be contemplated, it will be best to stop-out that part of the plate entirely and add new work afterwards in a later state of the plate.

### THE BITING-IN.

Before the plate is immersed in the acid it must have been painted on the back and edges with Brunswick black or stopping-out varnish, which must have been allowed to dry thoroughly. It is as well to get this done on a previous day. It is also necessary to examine the etching carefully, and paint with stopping-out varnish any accidental scratches that may have been made. You must wait till the stopping-out varnish is sufficiently dry to resist the acid, which is shown by its becoming dull when breathed upon. The plate may be then immersed in the acid bath. A frosted appearance on the lines will soon be seen, which consists of small bubbles, and must be gently removed with a feather or soft brush. While leaning over the bath, care should be taken to inhale the fumes as little as possible. Have by you a brass basin of pure water in which to wash the plate when it is withdrawn from the bath and your fingers in case you should wet them with the acid. When you think that the mordant has sufficiently corroded the palest lines, the plate is to be taken out of the bath. To avoid putting the fingers in the bath, a piece of wood cut thin at the end may be used to lift one side of the plate, and that part of the hand likely to come in contact with the acid should be slightly greased. The acid, if allowed to remain on the skin, produces yellow stains, which are not easily eradicated. The plate should be dried by fanning it, or with soft blotting paper. When it is quite dry the lines which are sufficiently bitten in are to be painted over with stopping-out varnish. The greatest care is necessary in doing this, as any part of a line that is overlooked, in a sky, for instance, may afterwards be found to be so deeply bitten as to give serious trouble. If at any time in doubt as to depth of line produced by the acid, a small part of the ground should be removed with spirits of turpentine, and the work inspected. This part must of course be stopped-out again before proceeding. Should the stopping-out varnish be too thick to flow readily from the brush, dilute it with spirits of turpentine. If, on the other hand, it be diluted too much, it is apt to run in the lines where not intended. The same process of immersion and stopping-out is to be repeated again and again, till the darkest lines are sufficiently bitten, or till the ground breaks up. Etchers vary to an extraordinary degree as to the number of stoppings out that they think needful. The practice of individuals of my acquaintance varies from four to twenty stoppings-out for the first state. My own experience is that about six give all the gradation that is required. The plate is now to be cleaned with spirits of turpentine or benzine, and to be taken to a good printer that the etcher may see what he has really done—in other words, to get a proof of the state of plate. A badly printed proof is often quite misleading, especially to beginners.

The first state of our illustration was done with five stoppings-out, and an immersion of twenty minutes in all—the mordant being ten parts of nitrous acid to nine of water, and the temperature of the room 56° Fahr. Wishing to get very great delicacy in the sky, I tried an immersion of only three minutes, with the result that the lines came almost too pale to be seen. The small tree on the right hand and the cliff on the left had twelve minutes in the acid, but show little or no difference, when printed, from the foreground shadows, which had the full twenty minutes.

I have made many inquiries of experienced etchers, and have consulted all the books I could come across, as to the proportions generally used of nitrous acid with water, and I find that they vary from the extreme strength of two parts of acid to one of water to the other extreme of one part of acid to five of water. The most common practice I believe is to use a mixture of about equal parts, slightly modified according to circum-

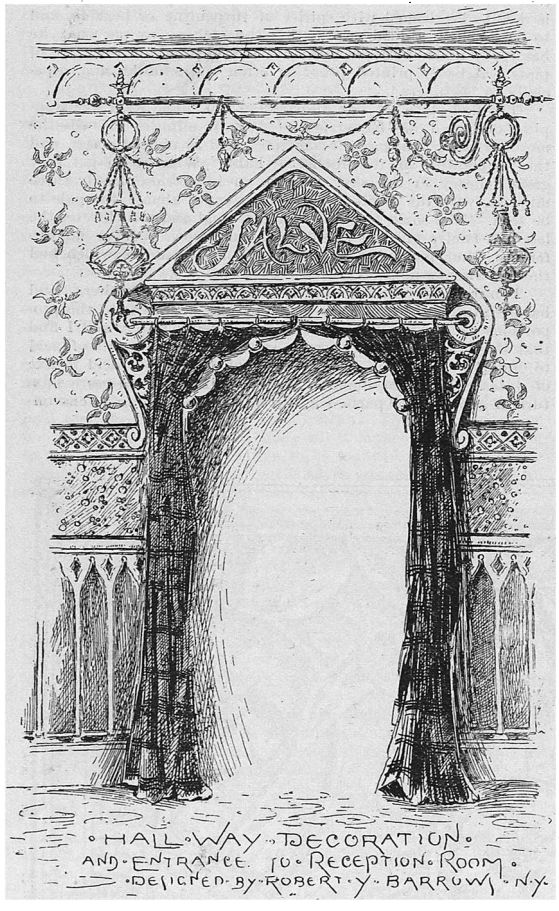


PANEL DRAWING, MARIGOLDS, SEMI-CONVENTIONAL, BY W. E. KETCHAM.

stances. Nitric acid is very similar to nitrous as far as etching is concerned, but is generally considered rather more uncertain in its action. The mordant that I have mentioned (ten parts of nitrous acid to nine of water) usually causes the lines to become grey or frosted in appearance in about half a minute; in four or five minutes the most delicate parts will be sufficiently bitten, and in twenty or thirty minutes of immersion the biting-in should be completed. Should the frosted appearance caused by the small bubbles become general over the plate in less than half a minute the action is too rapid to be safely trusted. The plate must be taken out of the bath and some water added. If, on the other hand, the appearance mentioned is not visible at the half minute, pure acid must be added till the requisite strength is reached.

If Mr. Haden's bath is used, a quarter of an hour is required for the most delicate lines, and about six hours for the deepest; but most etchers who use his mordant find it too slow, and modify it to suit themselves by the addition of more acid. Dr. Evershed adds also a small quantity of sal ammoniac, or sometimes common salt. At one time I used Mr. Haden's mordant regularly, and to render its action very uniform I kept it always at about the temperature of 70° Fahr. by means of the iron plate with gas jets beneath.

My reason for preferring a quicker mordant is that, by constant watching, one can see how the acid is working, and




proceed to stop-out accordingly. There are so many causes which may render the time test inadequate, that this is really of more importance than may at first appear. For instance, the acid works more rapidly in hot weather, and the varying density of different plates affects its action. Again, the quality of acid supplied by different chemists will be found to vary. After a bath has been used, the acid is of course weakened by the presence of the copper it holds in solution, and as few etchers use a fresh bath for every plate they do, it has to be strengthened by the addition of a small quantity of pure acid. This quantity has to be guessed at, so that the strength of the bath can never afterwards be accurately computed. Another fact which upsets rigid time calculations is that isolated lines are bitten much more slowly than those which are closer together. The reason is said to be that the temperature rises with the action of the acid, and that the hightened temperature thus produced where the lines are numerous intensifies the action of the acid on that part of the plate. Where biting-in is thus proceeding at a rapid rate, the amount of gas bubbles that keep forming enables the etcher to gauge the action of the acid. The plan I am recommending has the advantage that he who uses it increases his mastery of the method every fresh plate he does, while he who trusts to time tests is, after years of experience, liable to serious disappointment, owing, perhaps, to a chemist's mistake.

Before biting-in a plate of any importance, however, it is not a bad plan for a beginner to test his acid bath on a very small plate with a few lines scribbled on it, and noting the effect, say, of five, ten, and fifteen minutes' immersion. This will be found of some use if regarded as an approximation to what will happen with another plate, but must not be looked upon as a substitute for watchfulness during the process. Owing to the timidity of inexperience there is usually more danger of the beginner not biting-in his plate enough than of his overdoing it; let him take courage, however, when he learns that it is generally much easier to rectify a plate that has been overbitten than one underbitten.

(TO BE CONTINUED.)

## VENETIAN MIRRORS.

AS early as 1507 it was finally discovered how to replace the polished metal plates which had till then served as mirrors, by plates of ornamental glass with a metallic leaf fastened on the back. The Germans and Flemings had been more advanced for nearly a century, but at Venice they had gone back to the metal plates, when, in 1507, two inhabitants of Murano—Andrea and Domenico del Gallo, sons of Angelo—petitioned the Council of Ten for a monopoly of mirror glass for twenty-five years over the whole territory of the republic, and for permission to keep their fires lighted during the two months and a half when the fires of Murano were bound to be let out. This was the birth of an enormous industry, that of Venetian mirrors, an industry of the greatest importance even till recent times, and one which the most advanced nations have tried to appropriate.

THE first use to which glass was applied in Venice was in the preparation of enamel for the master-workers in mosaic, and from the eleventh to the fourteenth century this was the staple of the manufacture at Murano. It is evident to us that the Venetians had originally borrowed their methods from the Greeds, but in making these methods their own had considerably altered them. They made plates, or thin cakes of enamel, in black, brown, or red glass, about six inches across and a third of an inch thick. On this cake they put a square of gold leaf, and to protect the gold covered it with an extremely thin layer of glass, which made a glaze that both protected and gave lustre to the gold. The dividing of this cake into small cubes was left to the mosaic-workers, who cut them by a special process according as they were wanted. This, as we have said, was the most frequent use found for these cakes; but sometimes, and, indeed, very often, they were used for the incrustation of pulpits, altars, ambos, columns, pedestals, friezes, and tombs. Examples of this are very numerous all over Italy from the twelfth to the fourteenth century, but the most beautiful are to be found worked out by various architects at Ravenna, Rome, and at Florence.

PROFESSOR BLAKE thus describes a number of articles made of murrhine glass, which he had an opportunity of inspecting:—"There were silver goblets, or cups, with elliptical perforations, half an inch long at the sides, through which an inner lining of sapphire or ruby glass protrudes like gems. The whole surface seems set with round cut and polished sapphires or rubies. The glass lining of the silver is perfect throughout, but bulges and protrudes through the openings. It is evident that the silver goblet is first made and polished, with the openings left in the sides, and then, being warmed, is lined with glass by blowing a bulb inside of it, the lining protruding through the spaces. The linings were, of course, very tight and close fitting, and could not be removed without breaking or melting the silver. These cups are copied from an original in the British Museum. Sapphires, emeralds, amethysts, and rubies are thus imitated. A cup in imitation of onyx—a copy of one in the treasury of St. Mark's—was mounted in silver by Castellani; another, also copied from one in St. Mark's treasury, and mounted in silver by Castellani, has the colors of topaz and emerald. A *patera* in murrhine colors, white, blue and yellow, is a *fac simile* of the original in the National Museum at Naples."